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THE WEATHER AND CIRCULATION OF MAY 1970

A Generally Warm Month Associated With Small Amplitude Flow

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1. MEAN CIRCULATION

Two of the three major low-pressure centers normally present in the 700-mb circulation of May were in their usual locations this year, one near Baffin Island and the other near the Asian mainland over the Arctic Basin (fig. 1). The third major "center of action," which is ordinarily over the Bering Sea in May, was in the Gulf of Alaska. Comparison with the April circulation (Taubensee 1970) indicates that the main band of westerlies is contracting more rapidly than normal this year (fig. 2). Some concrete evidence for this is given by the fact that the subtropical westerlies over the western part of the Northern Hemisphere dropped from an average of 5.9 m sec^{-1} in April, which is considerably above normal, to a below-normal 2.0 m sec^{-1} in May, while high latitude westerlies in the same longitude remained above normal.

Associated with this contracting polar vortex were sharply rising 700-mb heights across the United States and the western Atlantic, with the largest height rise of 140 m just south of Newfoundland (fig. 3). Another area of large monthly change was the western Pacific, where a broad trough in April was replaced by a ridge during May. Positive height anomaly related to this ridge extended from the subtropics into the Arctic Basin (fig. 4). Other features of interest in the monthly mean circulation were the anomalous ridge over Scandinavia and the trough to the south over eastern Europe. The formation of the Scandinavian ridge, like the western Pacific ridge, was a reversal of the April regime. The resulting 700-mb height change was 140 m over southern Norway.

2. MONTHLY TEMPERATURE

The temperature anomaly pattern in the United States during May had a nearly north-south gradient compared to the predominantly east-west gradient of April. This change in the orientation of the temperature anomaly gradient reflects the decreasing amplitude of the upper level flow. Temperatures were mostly above normal in a broad band from the Northeast across the heartland of the United States through the Southwest (fig. 5). The strip of below-normal temperatures along the southern border was associated with easterly anomalous flow, cloudiness, and precipitation, for the zonal character of the midtroposphere flow assured that few incursions of polar air would reach the more southern States. Below-normal temperatures in the North were the result of both cloudiness and cold air advection.

Sacramento, Calif., with an average temperature of 67.7°F had the warmest May of record, but this was the only monthly temperature record reported. A number of daily temperature values across the Nation established new records. Most of the daily extremes during the first half of the month consisted of low minimums. In the latter part of the month, the majority of the daily records were high maximums. More of the extreme maximum temperatures occurred in the Southwest than elsewhere, contributing to the very large change in monthly temperatures for that region.

3. MONTHLY PRECIPITATION

Most of the precipitation during May was the summery type, frontal and airmass showers and thunderstorms. This would be expected with the small amplitude flow and generally warm temperature regime. Convective-type precipitation produces highly variable amounts over short distances, as illustrated in figure 6. Not all of the precipitation was typical of summer, for several inches of snow fell in early May over the northern Rockies, and snow flurries were observed in northern Minnesota and upper Michigan late in the month.

The heavier rains along the gulf coast were somewhat tropical in nature and were in keeping with the mean easterly anomalous flow (fig. 4). One tropical storm moved through the Southeast in May. Rains associated with this storm ended or at least interrupted a dry period in most of Florida.

The Southwest remained drier than usual. Phoenix, Ariz., reported its second consecutive month with only a trace of rain, and has had 82 days with no measurable precipitation. Mount Shasta, Calif., and Elko, Nev., have had 4 consecutive months with below-normal precipitation. San Diego, Calif., reported only slightly more than half normal rainfall since July 1969. San Francisco, Calif., experienced its third rainless May since 1850, and Red Bluff, Calif., with only 0.15 inches of precipitation since March 14th, reported the worst drought this early in the year since 1872.

4. INTRAMONTHLY CHANGES

A key factor in the large-scale circulation that con-

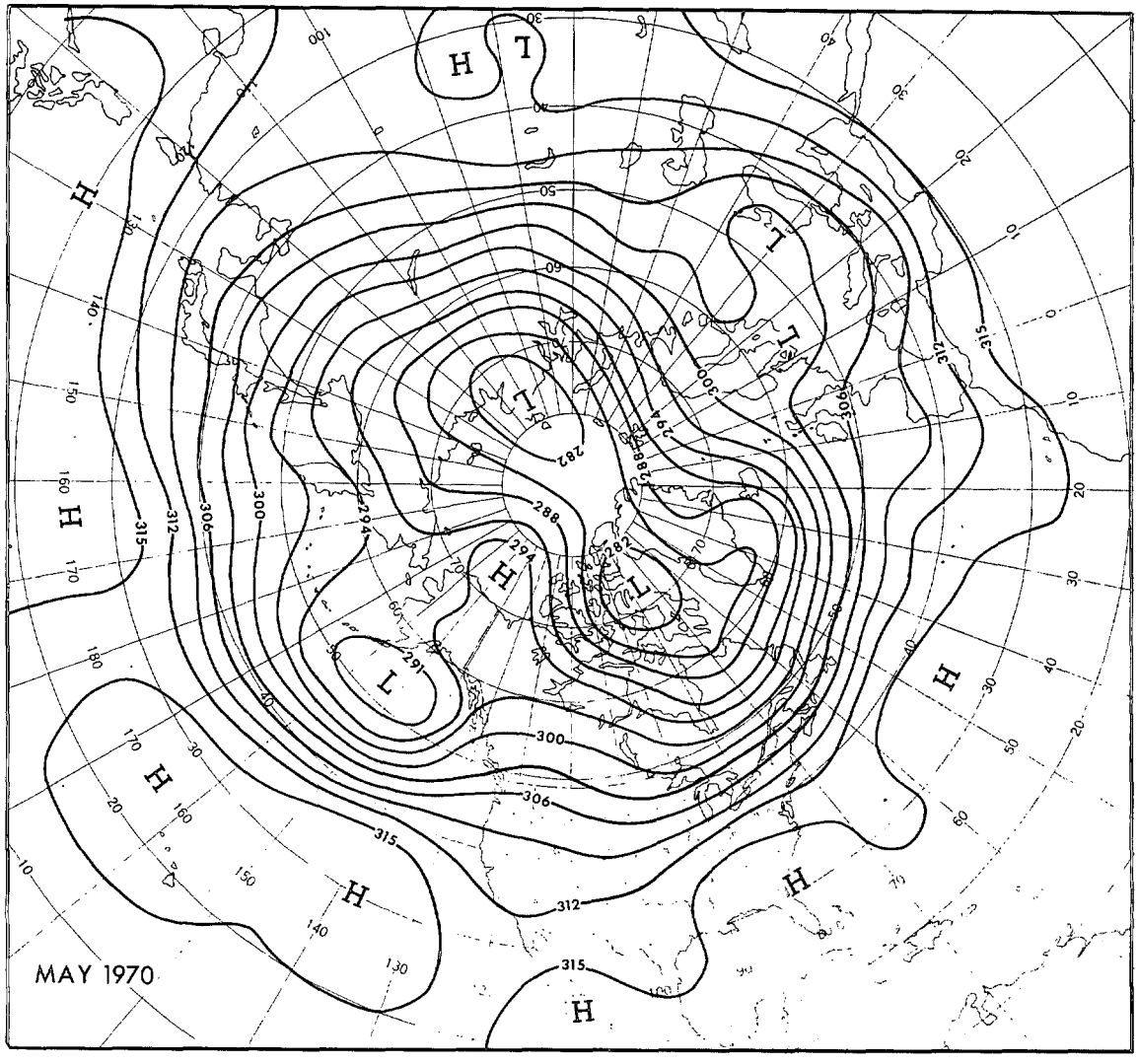


FIGURE 1.—Mean 700-mb contours (in decameters) for May 1970.

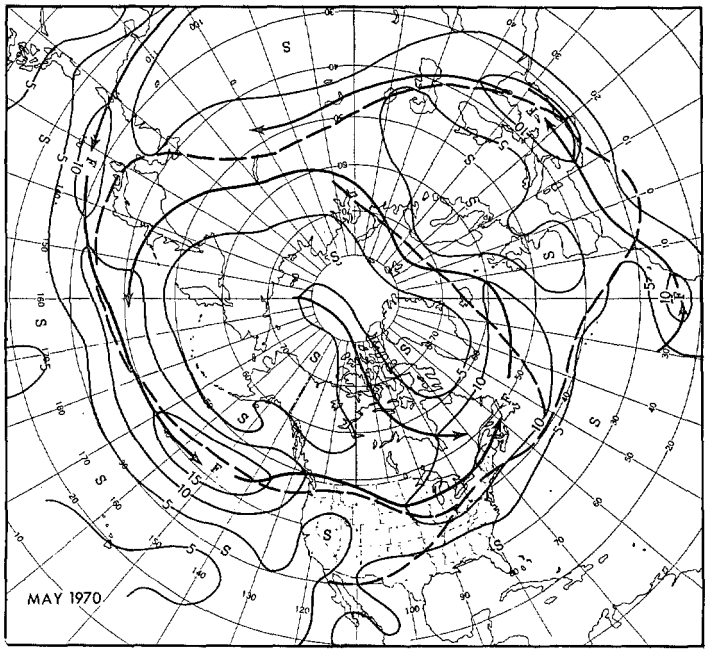


FIGURE 2.—Mean 700-mb isotachs (meters per second) for May 1970. Solid arrows indicate the observed axes of maximum wind-speed and dashed lines the normal axes.

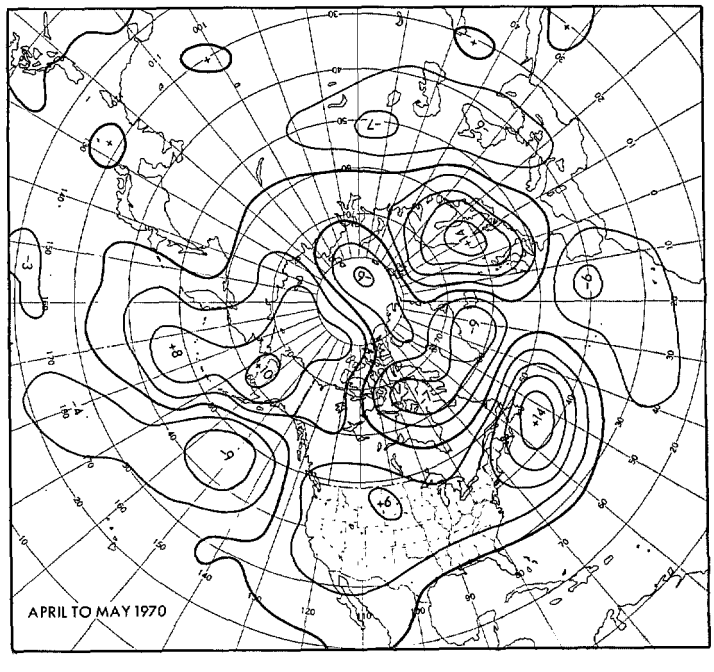


FIGURE 3.—Mean 700-mb height anomaly change (in decameters) from April to May 1970.

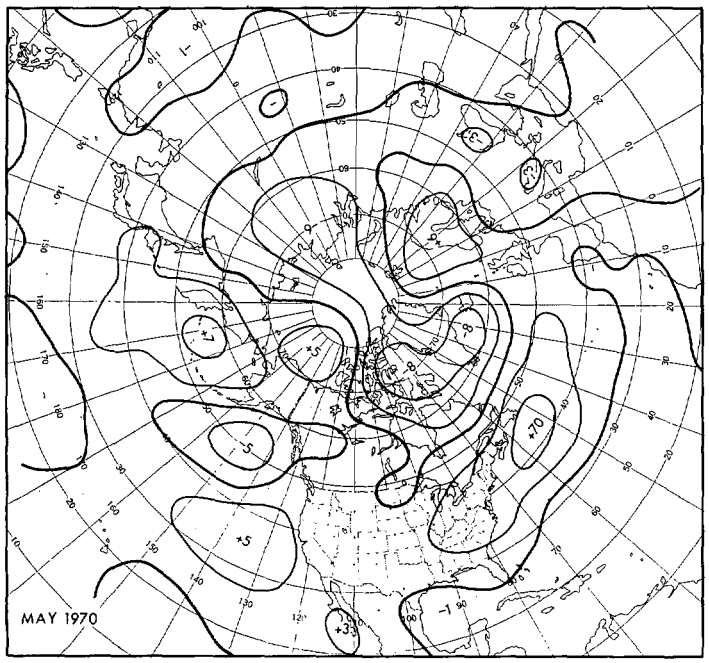


FIGURE 4.—Departure from normal of the mean 700-mb height (in decameters) for May 1970.

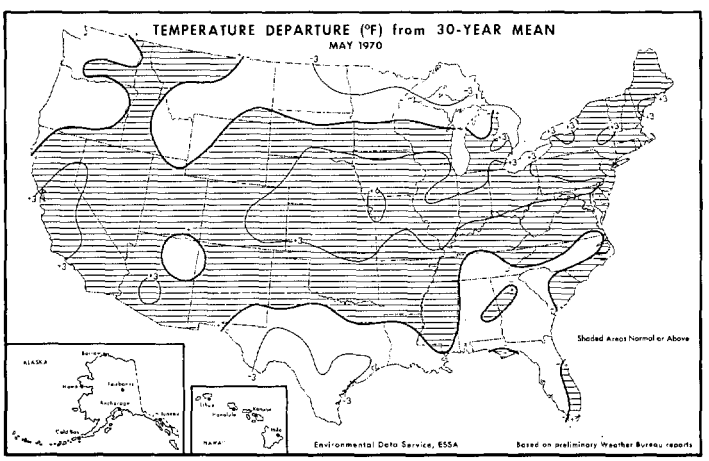


FIGURE 5.—Departure from normal of average surface temperature (°F) for May 1970 (from Environmental Data Service 1970).

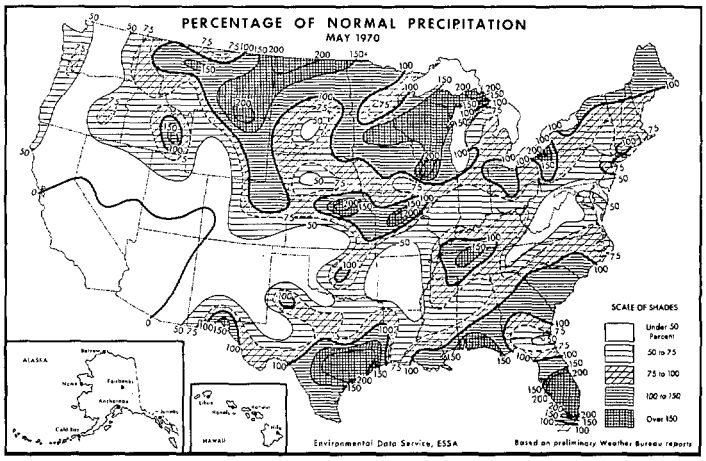


FIGURE 6.—Percentage of normal precipitation for May 1970 (from Environmental Data Service 1970).

trolled much of the weather in the United States was a strong upper level Low that moved into the Gulf of Alaska early in May and persisted through the month. Migratory troughs moving eastward from this mean Low caused considerable precipitation, yet these troughs were too shallow to force the cooler air very far south.

The 5-day mean circulation that spanned the last days of April and the first days of May (Taubensee 1970) had a large-amplitude trough in the middle of the country with ridges along the east and west coasts. However by the week of May 4–10, the upper level circulation had changed considerably (fig. 7A). The west to southwest flow east of the weak trough in the Southwest spread warm air across the central part of the country with most of the below-normal temperatures being confined to the peripheral States (fig. 7B). The cool air in the west was the result of advection from the Pacific, and the lower temperatures in the North were associated with cold airmasses that remained mostly in Canada. The relative coldness in the Southeast was a combination of advection and cloudiness.

During the first 4 days of May, a cold front swept through the eastern part of the United States giving copious rainfall from the Canadian border to the Gulf of Mexico, but most of this rainfall is included only in figure 6. The majority of precipitation in figure 7C was associated with a complex low-pressure area and frontal system that persisted for several days over the western and central states.

During the week of May 11–17, the trough that had been in the West progressed through the Great Lakes area (fig. 8A); but owing to the shallowness of this trough, only the northern States observed appreciable cooling (fig. 8B). The Southeast warmed rapidly as the ridge there increased in strength. The below-normal temperatures in the Texas area were associated with cloudiness and rainfall, rather than advection.

Besides the very heavy rains in Texas, heavy precipitation fell from Iowa and Missouri eastward to Pennsylvania as the trough progressed (fig. 8C). A number of tornadoes were reported from Texas to Ohio. One of these tornadoes struck Lubbock, Tex., killing 26 persons, injuring about 1,000 others, damaging or demolishing 8,800 family units, and causing property damage estimated to exceed $100 million.

Another weak trough moved into western United States in the third full week of May, while the ridge continued to strengthen in the East (fig. 9A). The resulting temperatures were mostly above normal from coast to coast (fig. 9B). The central part of the country was very warm, as well as the normally hot Southwest. Several maximum temperature records were broken this week.

Most of the rains early in the week were scattered light airmass showers. Frontal activity during the latter part of the week produced generous showers from the Rocky Mountains to the east coast (fig. 9C). The heavy rains in eastern Texas were caused by a weak cold-core

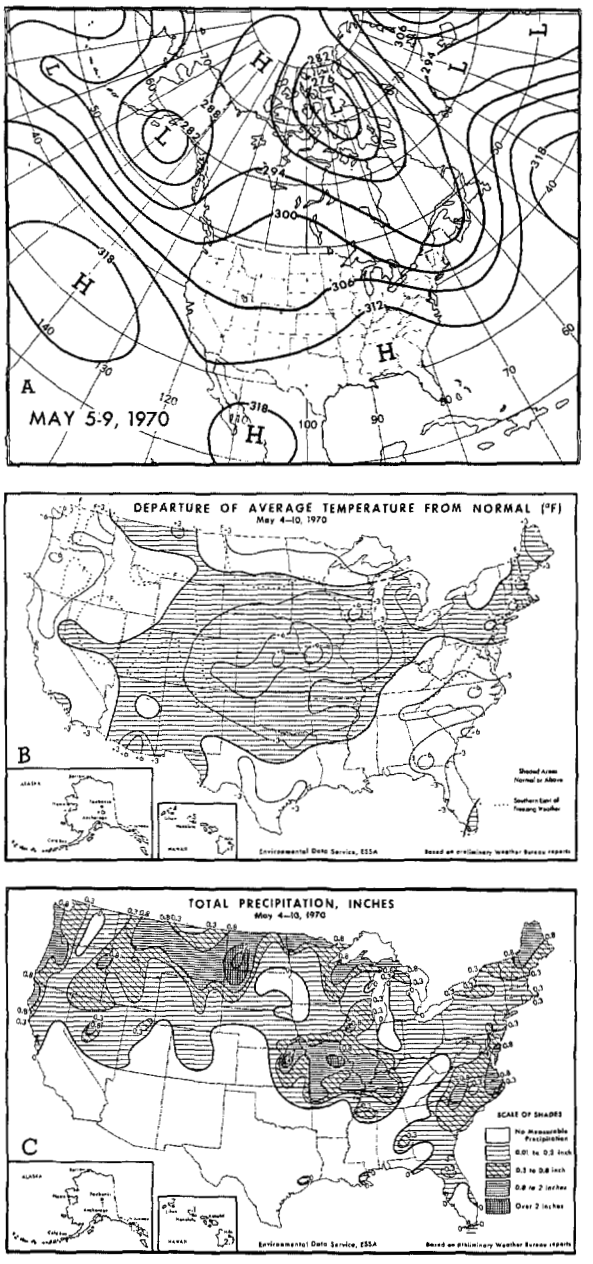


FIGURE 7.—(A) mean 700-mb contours (in decameters) for May 5–9, 1970; (B) departure of average surface temperature from normal (°F) and (C) total precipitation (inches) for week of May 4–10, 1970 (from Environmental Data Service 1970).

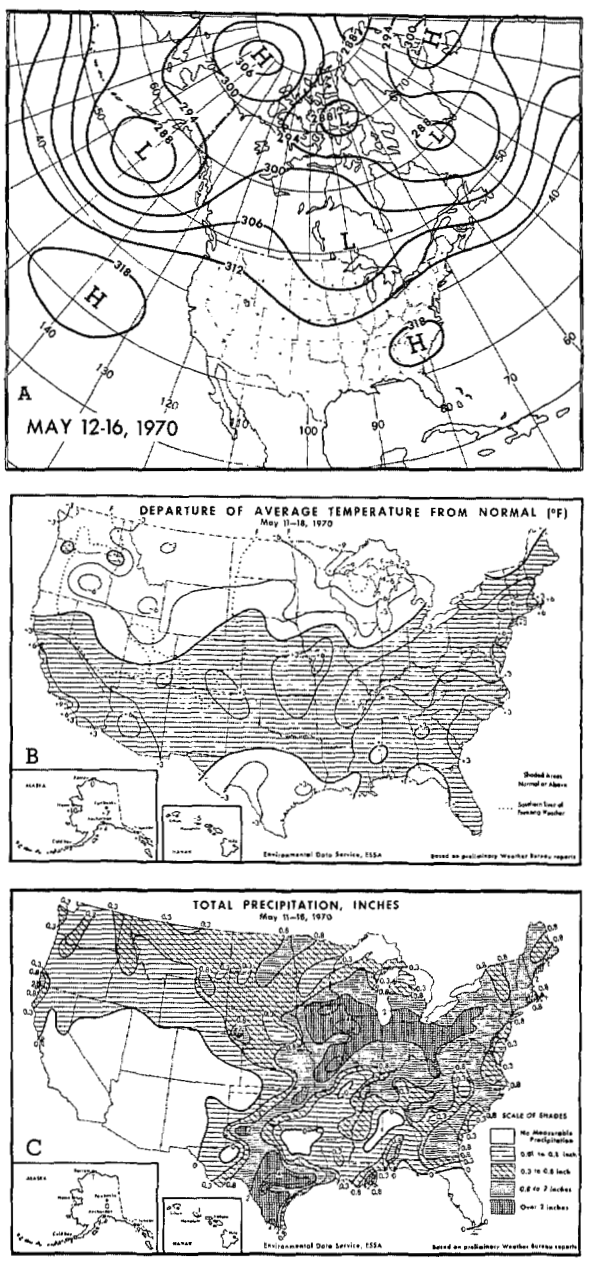
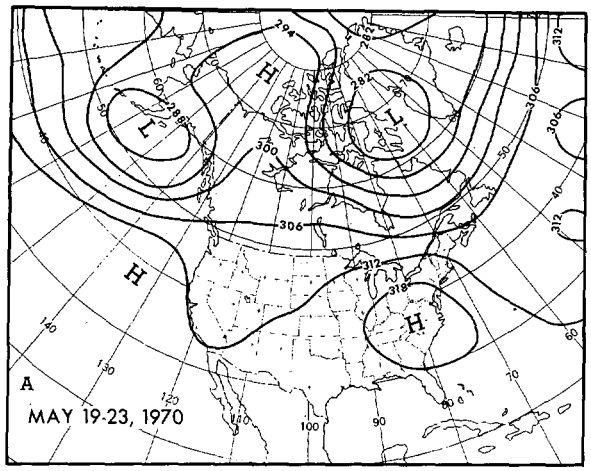


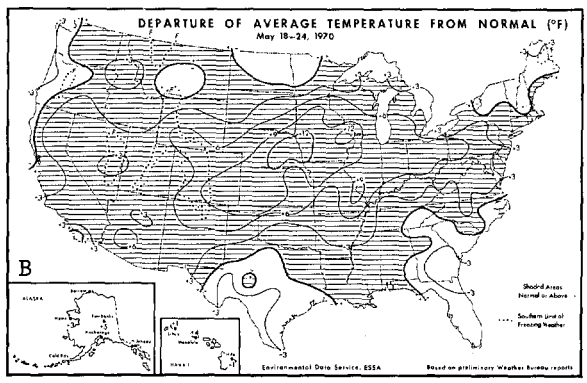
FIGURE 8.—Same as figure 7, (A) May 12–16, 1970; (B) and (C) for week of May 11–17, 1970 (from Environmental Data Service 1970).

upper level Low that formed over the Gulf of Mexico from the southern part of a migratory trough and drifted inland, being steered by the southeasterly flow of the strong eastern High.

In the final week of May, the western trough again progressed, under the "pumping action" of the almost stationary Low in the Gulf of Alaska (fig. 10A). Cooling occurred in most of the States except those in the Far West; but as in early May, because of the small amplitude of the trough, large parts of the country remained warmer than normal (fig. 10B). The negative temperature anomalies in the South were largely the result of cloudiness and precipitation, although a cool front did move into that area.

Most of the precipitation late in May (fig. 10C) was associated with fronts, but a large part of the heavy rains from Texas eastward were caused by weak upper level troughs moving eastward along the southern border. Also, the remains of the first tropical storm of the season, Alma, moved through the Southeast this week. Alma formed the previous week near Jamaica and reached hurricane strength rather rapidly. Then, after decreasing in intensity and stalling south of Cuba, this Low drifted northward near the western tip of Cuba and through the Southeast. Locally, very heavy rains occurred as Alma moved through the region, including 9.60 in. at Fort Lauderdale, Fla. A tornado was reported near Columbia, S.C., as the storm passed.





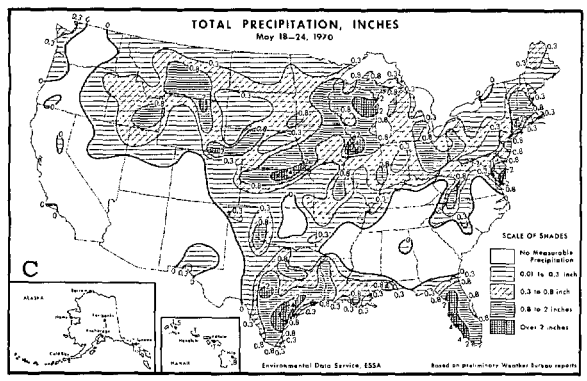
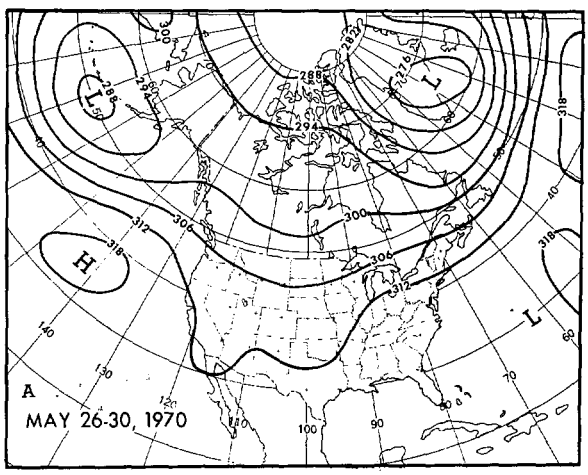
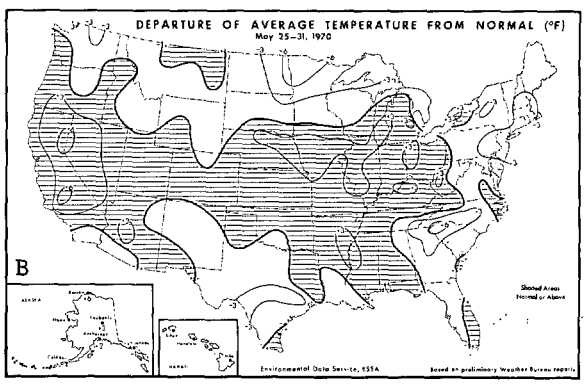


FIGURE 9.—Same as figure 7, (A) May 19–23, 1970; (B) and (C) for week of May 18–24, 1970 (from Environmental Data Service 1970).





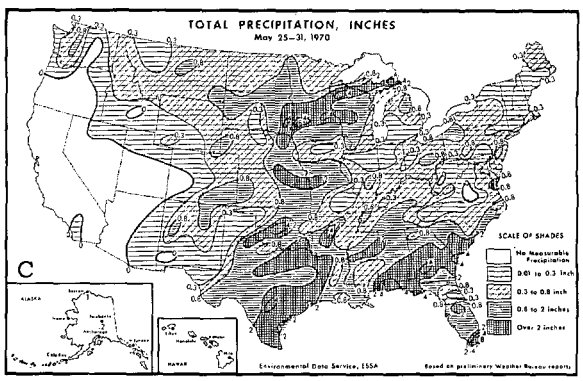


FIGURE 10.—Same as figure 7, (A) May 26–30, 1970; (B) and (C) for week of May 25–31, 1970 (from Environmental Data Service 1970).

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